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ESCAP Regional Energy Development Programme (REDP)
Regional Network for Small Hydropower (RN-SHP)

Technical Advisory Group (TAG)
First Meeting

Hangzhou, China, 11 - 13 December 1984

COUNTRY PAPER: SRI LANKA*

Prepared by

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1.0. Introduction

Sri Lanka situated between the Lattitudes of 6°- 10° - North and Longitudes of 80° - 82° - East is characterised by geoclimatic fratures of central hills rising over 2500 m with steep slopes providing drainage basins for around 100 rivers, to emanate in association with areas of annual rain fall of over 5000 m.m.. However the average annual rainfall varies between 2500 - 4000 m.m. in the dry and the wet zones respectively. These and many other factors such as large irrigation projects have lead to the development of many of our hydro resources. For the past few decades hydro power constituted a major resource adaptable for both mini and major type of development. The realisation of this fact is and was the primary consideration of our country's effort towards the development of commercial energy through the exploitation of indigenous resources for its economic activities.

With the development of our tea industry and rubber industry which are two of our major foreign exchange earners mini-hydro power plants were developed. Most of these plants were used to provide motive power to almost all our tea factories and a good number of Rubber factories. Some of these were used to produce electricity for useage in the factory and staff quarters in the estate. Almost all these plants were erected in the pre-independence era and most of it came from England. Most of these plants dates as far back as 1920. These Mini Hydro (you may even call them Micro Hydro) power facilities of the pre-oil era were simple yet rugged and took advantage of the characteristics of the terrain in locating the factory and the power plant as a single unit where harnessing of maximum power potential was not the primary consideration. They proved their effectiveness over time though were less efficient compared to present day developments and required minimal maintenance and not too highly qualified or trained staff for their erection, operation and maintenance.

This time proven technology which successfully made it possible to harness an inddigenous resource, unfortunately was displaced by the then cheap fossil fuels. Subsequent development of hydro power under major hydro power development projects and the extension of the national grid network to these agro industrial areas was responsible for the 2nd stage of displacement of the oil fueled Prime Movers by electric motors. Although this amounted to the useage of an indigenous resource Viz. hydro power, it still deprived the country of harnessing the mini-hydro potential to added economic advantage. The second stage of displacement to some extent had been the result of a short sighted policy consideration applied at a time of cheap and abundant energy which prohibited the use of grid electricity as a stand-by supply, to other forms of energy delivery.

In recent years as a consequence of the rapidly rising imported fossil fuel prices and very high costs associated with the development of major hydro facilities and extension of the national grid network and the long lead time required for such activities, development of small and mini hydro - power potentials are receiving considerable attention in Sri Lanka.

In the national plans and policy approaches for the energy sector development mini-hydro development receives high priority and the present development effort is concentrated in the following.

(a). Revival of those abandoned mini-hydro power facilities in tea estates where most of the equipment and structures of the original facilities are yet in existance in fairly good condition.

(b). Revival of other sites where high power and energy potentials are available.

(c). Identification and development of potential mini-hydro sites as applied to

i. Stream and river flows.
ii. Irrigational water releases from major irrigation tanks and sluices.
iii. Irrigational canal flows and canal drops.

There is growing awareness of the need and relevance in the development of the Mini-hydro power particularly for the agro industrial sector. The country also accords priority to mini-hydro power development, yet the progress achieved so far has been rather insignificant. The primary reason for this is the lack of adequate resources. The implementation of a large number of mini-hydro projects scattered in many remote parts of the country, demands the simultaneous development of all available resources. The popular concept that mini-hydro is small and therefore manageable could not be accepted as it would still make demands on all the different types of expertise, materials, trained personnel etc. in quality though not in the same quantities as in a major hydro power development project. For mini-hydro to make any impact in any country's energy scene a large number of mini-hydro projects will have to be considered for implementation within a given short span of time. In such a situation the demand on a country's available resources would indeed be beyond the limits of attainability.

Sri Lanka's already scarce financial, materials, and trained man power resources are committed to the major multipurpose power and irrigation development projects under the accelerated Mahaweli programmes. Even if financial resources could still be found for well conceived cost effective project proposals, yet the acquisition or the development of the man power resources needed for their implementation would indeed be a difficult task to accomplish in a short time span.

This paper outlines many such priority areas which needs an immediate and sincere attention if SHP development is to survive. If not we are neglecting this once a vital source of energy in our region for more superior, sophisticated, capital intensive source of energy.

2.0. Priority subjects to be addressed :

The establishment of the Regional Network for Small Hydro Power in itself underlines the necessity for co-orporation and dissemination of information for development in our region and the respective countries where small hydro power activities are concerned. The vital areas of dissemination of information could include the following.

a). Emphasis on Training Courses to develop human resources.
b). Manufacturers and suppliers of SHP equipment in the region.
c). Encouragement and incentives for the publication of all R & D activities already accomplished in the region.

2.1. Education & Training Needs :

Education and training needs steam from the national goals objectives and aspirations and the scope of activities that has to be undertaken to realise these goals and objectives. Such activities and parameters for consideration with regard to the mini-hydro power development would encompass.

a). Identification of potential sites.
b). Collection and analysis of hydrological topological and geological data.
c). Power and Energy potential evaluation.
d). Diversion dams and storage facilities.
e). Intake structures and water conveyance systems.
f). Penstocks and surge tanks.
g). Turbines and generators.
h). Speed, load and voltage control equipment and protective gear.
i). Power house and ancillary equipment.
j). Energy supply and demand features and load despatching equipment.
k). Cost benefit and other economic considerations financing mechanisms.

l). Construction management.

m). Operation, Maintenance, trouble shooting and overhauling.

n). Social and environmental aspects.

Mini hydro power generation is highly site specific to be viable technically and economically. The particular site that would provide maximum power potential may not necessarily be the site acceptable on optimum cost benefits. Mini-hydro stations could be located on small streams, at canal drops, anicuts, at head works of irrigation dam sites etc. Preliminary field data such as flow details, available head, load centres in the vicinity, existance of power lines etc. will be useful in the identification of potential sites before attempting any detailed investigation.

Collection of flow data and assessment of yield is essential for the successful development of mini-hydro potential. In cases where these data is not available which is true of many cases assessment of yields by correlation of rain fall and run off, or use of empirical relations or the adaptation of data from similar catchment, etc. may have to be resorted to. River or stream gauging may become necessary. Flow duration curves for a good bad and average year or a representative year could be constructed from daily flow data collected over a sufficient length of time.

Topographical surveys covering the areas required for Head works, water conveyance systems, Power House and Tail Race are required to provide the ground features etc. In canal drop type of mini-hydro schemes upstream and downstream water levels, flow profiles, cross sectional details of canal bed with slope etc. are needed. For the collection of these details survey and levelling techniques in the civil engineering practice will have to be deployed. Head and tail race water elevation for various discharge, sumberging areas, capacity curves, gross head availability etc. will have to be worked out.

Detailed geological exploration as in major hydro schemes is not warranted in most mini-hydro schemes. However basic knowledge of the geology would be helpful in deciding the location of the dams water conveyance systems and Power House etc.

Basic engineering knowledge will be required to compute from the data collected, the power and energy potential available from a particular mini - hydro site. The analysis of the information will also provide the basis for deciding the number of units that would be fixed, although the present trend is to adopt a single unit.

Basic knowledge of the types of turbines, generators, control mechanisms and their characteristics, capabilities, advantages and disadvantages etc.are important considerations for education and training. Different types of dam structures selection criteria for local and alternate materials that could be used in construction, design of intakes, water conveyance systems surge tanks, penstocks, use of appropriate and alternate materials and special design considerations for the penstocks etc. are other areas where enhanced knowledge and understanding is required to be provided to undertake mini-hydro programmes successfully.

The success and the economics of a mini-hydro scheme in a remote location wouod depend on the load demand characteristics of the area serviced and to the extent to which the proposed scheme could satisfy these load requirements. Therefore careful assessment of the present and the future power and energy needs of the area will be required for the proper planning of the scheme and also for phasing out of the development in steps to make use of the resources to the best advantage.

Mini-hydro schemes with small or daily service type of storage, water availability and the energy requirements will have to be matched so as to be able to meet the demand in the best possible manner if very expensive alternative energy options are to be avoided, which could negate the whole economics of mini-hydro generation. The engineering knowledge that has to be imparted should therefore essentially cover the improvement of the abilities of the individual to successfully resolve such challenges in planning.

Basic knowledge in principles of economics, statistical analysis, computer modelling etc. are other areas of specialisation in planning and programming of mini-hydro power. The ability to evaluate a proposal on mini-hydro on its long term cost benefits is a fundamental requirement for the securing of the necessary finances from lending agencies etc.

2.2. Manufacturers and Suppliers of SHP Equipment

The feeling which is prevelent in most of our planners still which presumably is inherited by us from our colonial rulers, being that the best performing equipment can only be imported from developed countries is not only a myth but hazardous for the successful implementation of an effective SHP development project. It would be true to say that this was the case some decades back when the local industries in this region was at its infancy. There is sufficient evidence to believe that at present local manufacturing industry of small machinery has reached full maturity for us to be able to compete well with these high cost, high technology equipment from the developed countries. It would be unwise to state here that these equipment are redundant but the fact should be emphasised that each piece of equipment should be evaluated on its cost effectiveness.

The above should always be complimented with a proper alternative suggestion of encouragement, provision of incentives and popularisation of local machinery. Without such scheme to popularise, advertise and market the SHP equipment that could be produced locally the results may be discouraging. Hence the necessity for a proper scheme to popularise advertise and market these equipment is inevitable.

Popularisation could be achieved by demonstration. This could be done by Government sponsored projects or projects sponsored by an international funding agency, always using well proven technologies with simple, unsophisticated parts that could easily be substituted or manufactured by a local craftsman.

The advertising and marketing facilities would evolve with the popularisation effort and this could further be supported by distribution of brochures, news bulletines, and popular magazines.

2.3. Dissemination of R & D effotts :

Much effort is being wasted in this aspect mainly by duplicating the work carried out by already established organisations geared for these activities. On the other hand less R & D work is being undertaken in certain areas of SHP development such as cost reduction techniques, effective technologies and adaptability of already existing technologies.

The other aspect of R & D activities in the region should be to encourage the researchers to do much wanted and relevant research work and proper dissemination of this work henced it is very important that all research organisations be identified firstly under the RN - SHP sub focal points then also under the RN - SHP itself. It would be a worthwhile effort to coordinate these activities both at national level and at regional level and all the activities be properly documented so as to give wide publicity to such worthwhile activities and to encourage other users in the region the facility of availing themselves of the latest technique and technologies thus developed.

3.0. Research Project

High priority area in the region could be classified as follows :-

a). Simultation of climatological condition.
b). Remote controlled and un-attended operations.
c). System cost optimisation of SHP.

The above three priority areas are to a great extent interrelated to each other and needs greater attention in our future SHP development activities.

3.1. Simultation of climetological conditions

This is one of the most unreliable parameters of the design of a proper SHP project but nevertheless one of the most important in the whole exercise of the design. In almost all the cases of sites selected for SHP development it has been observed that the rain-fall patterns, river-flow data are very scarcity and unreliable. Nevertheless the designs will have to adopt some criteria of flow duration curves and other required data. Hence the need for the development of appropriate mathematical models or empirical relations is very essential. The development of such a programme is extensively dealt with under section 2.1 and it need be only emphersised here that this aspect has to be given much needed coordination by our eminent researchers in the region both in the organised establishments and in the Universities offering hydrology as subjects.

3.2. Remote controlling and un attended operations

It is our experience that many SHP projects fail to materialise for / the lack of available trained personnel to handle such projects and also for operation and maintenance of these plants. Many of the plants now abandoned or ruined are due to this fact. Therefore it will be a worthwhile exercise to focus our attention to the remote controlling facilities. Taking advantage of the fact that these SHP schemes could be connected to the National grid or could form themselves into local mini grids the possibility of remote controlling and centralised operation could be considered.

Telemetering and remote controlling has been in operation in our countries for sufficient length of time that the experience gained and the expertise developed is available. It would be only necessary to develop clusters of SHP projects to form themselves to be centrally operated by a few skilled and trained personnel. Thus eliminating numerous problems associated with the lack of trained personnel who are in most cases unwilling to serve in remote areas. It should also be mentioned here the advantage of eliminating all associated overheads involved with staffing a manned power plant.

3.3. System cost optimisation of SHP

This is one of the least addressed subjects in the field of research in our region. It has always been the case for some one other than the designer to evaluate the project where cost effectiveness is concerned mainly for funding purposes. The need for closer understanding of the cost VS. the design parameters is a pre-requisit for cost optimisation of a such project. Ready reconners and computer models should be developed and in cases where it is already developed it should be modified wherever possible to correlate the design parameters of the system with the cost and economic parameters.

The expertise available in our countries could be well utilised for the development of such econometric models to run on micro processors or results of such runs to be made available to our designers as ready reconners.

4.0. Country Specific Projects

Several projects which could be carried out within the country by taking a leading role could be identified as follows :-

a). To act as a focal point for information dissemination.
b). To scrutinize and forward suitable candidates for proper training within the guidelines set out in the section 2.1.
c). To coordinate activities of fellowship receipients
d). Organisation of seminars, meetings and workshops on SHP.
e). Monitoring on hardwear development effort.
f). Market penetration studies.

The above is a list of possible areas of corporation within the region but with our country's participation in taking a leading role. The above subjects are dealt with in a preceeding section and need not to be ellaborated here. It should however be emphasised here that with the on going major development works being undertaken by the government at present it would be difficult to raise funds for such activities other than the services offered by personnel already employed in governmental institutions dedicated for the development of SHP activities.

5.0. Personnel and Organisations involved in SHP activities.

A survey is being carried out by the Ministry of Power and Energy to enlist ¨xperts, consultants, engineering companies, equipment manufacturers and civil works construction companies who could possibly take part in SHP development activities. This survey is still in progress and results are expected to be available in a very short time. Once a comprehensive list of the above is compiled it could serve in the selection onon personnel and organisations dedicated for SHP activities. The organisations which used to erect and maintain the already existing mini hydro plants in the country will be the main organisations to take a leading role in the future SHP development activities too.

6.0 Conclusions :-

The creation of the regional net work for small hydro power is to focuss attention where SHP activities are concerned. The effective link established through these organisations will in the future be the nervous system that would nurture the development of all future SHP development activities. To this end the Sub-focal point in Sri Lanka could play a major role in the future activities of the RN - SHP.

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COUNTRY PAPER: THAILAND*

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Introduction

Although small hydropower plays a modest role in Thailand's energy scenarios in comparison with fossil fuels and major hydros in rural electrification, it gains substantial momentum, especially in the area where villages are so widely dispersed and far from national grid that the extension becomes economically and technically unfeasible. Nevertheless, its widespread has been hampered by its high capital cost which resulted in the unfavourable long period of investment return. To enhance bright prospects of small hydropower in future, serious considerations should be taken so that all possible activities be oriented towards solving this hinderance.

1. Priority Subjects

The meetings and workshops on small hydropower organized previously could be considered as satisfactory. However, subjects dealt with in those meetings were oriented towards fundamental knowledge of small hydro development. They are excellent in their own context but their contribution to the cost reduction of the project is questionable.

With this concept in view, priority subjects for future expert group meeting, workshop and training courses are thus proposed as follows:

i) Expert Group Meeting

Subject — Feasibility study

Objective — To identify various drawbacks and inappropriate criteria and methodology currently employed in the feasibility study of small-scale hydro and formulate a new internationally recognized standard manual, specifically tailored for the feasibility study of small-scale hydro schemes.

Participants — Experts from member countries as well as from international and United Nations Organizations and from technical and financial sectors.

Justification — Feasibility study is the decisive factor for the existence of project and it is mandatory. Since small-scale hydro is rather a newly emerging area, the criteria and methodology currently employed by the financial institutions was adopted from the conventional one used for the feasibility study of major hydro. They are inappropriate and consume substantial time and money, which small-scale hydro cannot afford. In addition they are oriented towards financial benefits rather than economic. As a result many projects good for rural development were discarded simply because their overwhelming intangible benefits could not be counted in the evaluation and the projects thus became infeasible. A new criteria and methodology specifically tailored for small-scale hydro have to be innovated.

ii) Workshop

Subject — Design and construction of low-cost civil works

Objective — To exchange and compile information and experience in the design and construction of low-cost civil works in various countries.

Participants — Experts from implementing agencies in small-scale hydro from member countries and also invited experts from outside the region.

Justification — The major cost of the small-scale hydro is the civil works and in some cases occupies as much as two-thirds of the project costs. The simplified standard design and construction approach to alleviate the cost of civil work will help to increase the economic viability of the small-scale hydro projects.

iii) Training Courses

a) Subject — Civil Works Design

Objective — To train junior civil engineers in the design of low-cost civil works.

Trainees — Junior civil engineers from the region.

Justification — Civil works is the major investment portion of the small-scale hydro. However, the civil work can be designed and constructed by local engineers at reasonable cost providing that they have the appropriate information and experience. Unlike the mechanical and electrical counterparts, the knowledge of civil design existed in all countries of the region. In addition, their acquaintance with local materials available and site conditions offer merits of their work. In many cases, especially for small hydro in remote areas, these qualifications have evidently proved to be of great advantages to the design of low-cost civil works. This course will broaden the horizon of these engineers and thus strengthen their capabilities in this field.

b) Subject — Small Propeller Turbine Design

Objective — To train mechanical engineers in the design of small propeller turbine for irrigation canal.

Trainees — Mechanical engineers

Justification — In rural areas of many countries in this region, the governments have constructed many small weirs and canals for irrigation. These weirs and canal drops offer excellent small hydro potentials for electricity generation or mechanical power that the farmers in the vicinities can utilize. Yet, these potentials have not been harnessed, its constraint is the costly generating equipment, particularly the turbine. Therefore the know-how of small propeller turbine design, probably in the range of 1 to 5

kilowatts, and exchange of information on locally manufactured low-cost propeller turbine in order to increase the productivity and improve the quality of life of a large sector of population will be greatly beneficial to the rural poor.

2. Priority Subject Areas for Joint/Co-operative Research Projects

In hydro-electric generation it is vital that the frequency has to be constantly maintained no matter how the load varies. Normally, hydraulic or electro-hydraulic governor is used for controlling the speed. This type of governor required sophistication in design, precision in manufacturing and highly trained personnel to adjust and maintain. Therefore, they are supplied by only a handful of manufacturers around the world, and of course, at a very high price. The electronic load controller recently developed and introduced to the market opened the new era of low-cost, but near free maintenance governor.

In our experience as the user and manufacturer of the load controller under the license from U.K. for over five years, the load controller proved its claim. However, its limitation in capacity (not over 100 kW) and in application (consistent amount of water discharge)and the problem of heat dissipation of the dummy load together with its performance that does not allow synchronization with other machines made its application confined to the small, isolated run off the river with high discharge hydro scheme. Nevertheless, its concept and performance are quite impressive. In addition its low-cost makes it challenging to explore into the possibilities of modifying it for flow controlled application. In this new application the electronic part will function as a frequency sensor. The change in frequency as the result of the load variation will transmit the electric command signal to drive the gear motor coupled to the flow control valve which will increase or decrease the flow according to the requirement. Thus the turbine speed will be constantly maintained.

At present, the National Energy Administration is developing this type

of governor. The performance of the prototype simulated in the laboratory was encouraging and actual field test will be carried out soon. However, the perfection of its performance requires further research work. In this regard, Thailand proposes the development of this type of governor as the priority subject area for joint and co-operative research projects.

3. Areas and Type of Activities where Thailand could take the Lead for Organizing Decentralized Projects, Subject to Availability of Financial Support

The area of activities that Thailand can propose to take the lead for organizing decentralized projects is on-site training course on the co-operative approach in the management of construction and operation of small hydro for rural villages.

In Thailand, many rural villages in remote areas, have enjoyed better quality of lives through electricity from small decentralized hydro power developed and managed by the villages themselves. In each project the villages will form among themselves a co-operative in joint venture with the Government to construct small hydropower stations in their vicinity. The villages contribute free labour and free local materials. The Government provides the rest including generating equipment as well as technical assistance. The contribution from two sectors will be converted to shares which will be held by all participants. The revenue from the electricity will be shared among the shareholders. With this approach the Government can reduce the investment on rural electrification and allocate the burden on the operation and maintenance on remote decentralized stations. The villagers on the other hand, will benefit from the increase of productivity and enjoy better living conditions through electricity and co-operative benefits.

This approach can be duplicated in every country in the region providing that the technique of management and the will of people to co-operate exists. Thailand proposes to offer on-site training course in this know-how to the countries of the region, subject to availability of supporting funding will be made available from the UN organizations.

5. Information on experts, consulting and engineering companies, equipemnt manufacturers and civil work construction companies engaged in small/mini hydro power activities*

Quite a number of experts on small/mini hydro activities in every discipline such as hydrology, engineering, geology, etc., are available in Thailand. Most of them work with the Government sector. In the case of equipment manufacturers, there exists one each for turbine and generator manufacturer and their products were confined to small units (below 500 kilowatts) for domestic use. However, they have entered into agreement with a European manufacturer to produce the bigger unit for domestic use as well as for export in the very near future. In case of the transformers, several manufacturers exist and their products are of top quality and gain good reputation both at home and abroad. As for consulting and engineering services over a dozen of companies have good qualified personnel and experiences. Double of this figure are engaged in civil construction. In short, Thailand is well equipped as far as planning and civil construction are concerned, but in the case of generating equipment, the need to import big size units still exists.

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* Mention of firm names and commercial products does not imply the endorsement of the United Nations.

ANNEX I

CONSULTING FIRMS IN THE MINI HYDRO PROJECTS

1. Team Consulting Engineers Co.Ltd.
2. K. Engineering Consultants Co.Ltd.
3. National Engineering Consultants Co.Ltd.
4. Thailand Institute of Scientific and Technological Research
5. SPAN Co. Ltd.
6. National Engineering Consultants Co.Ltd.
7. Soil Test Siam Engineering Consultants Co.Ltd.
8. Asian Engineering Consultants Co.Ltd.
9. Resources Engineering Consultants
10. TESCO Ltd.
11. Thai DCI Co.Ltd.
12. South-East Asian Technology Co.Ltd.

ANNEX II

CIVIL CONTRACTOR

1. Chiengmai Construction (1979) Co.Ltd.
2. Siam Civil Engineering Co.Ltd.
3. Italian - Thai Development Corporation
4. Prasong Transport Ltd.
5. Chiengmai Asia Co.Ltd.
6. Sang Patana Construction Co.Ltd.
7. San Pa Khoi Construction Co.Ltd.
8. Thai Industrial and Engineering Service Company Ltd.

EQUIPMENT MANUFACTORY

	Name	Product
1.	Thai Generator Co.Ltd.	Generator and Switchboard
2.	Thai - MC Co.Ltd.	Turbine and Generator
3.	Sirivivat Co.Ltd.	Transformer
4.	Thai Maxwell Co.Ltd.	Transformer
5.	Ekarat Engineering Co.Ltd.	Transformer
6.	U-Tah Engineering Co.Ltd.	Switchboard
7.	T.S.M. Electric	Transmission line equipment
8.	South-East Commercial	Turbine and Generator
9.	Siam Syndicate Co.Ltd.	Valve
10.	Mining and Industry Metal Work Ltd. Part.	Turbine

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NATIONAL LEVEL PRIORITY SUBJECTS FOR THE PROMOTION AND DEVELOPMENT OF SMALL HYDROPOWER

Information compiled by the
UNIDO secretariat on the basis of
papers submitted by members of the
Technical Advisory Group*

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I. CHINA

1. Priority subjects for workshops and training courses

Feasibility study - In this area, China has developed her own methods suited to the particular conditions in China. However, we are keen to learn from the experiences of other countries, and can help in organizing such a workshop or training courses.

2. Joint/co-operative research projects

i) Electronic Load Controller - China has already completed a first stage research project on the testing and trial operation of an ELC in conjunction with the Intermediate Technology Development Group (ITDG). The results of this showed that two major problem areas are "how to reduce the cost" and "how to more effectively utilize the ballast load".

China is therefore embarking on the second stage involving the local assembly of 60kW ELC kits supplied by ITDG, and with the testings to be carried out in China and two other Asia-Pacific countries.

The results of this can then be disseminated throughout the RN-SHP to promote the wider use of ELCs.

ii) Remote control and automation of SHP stations - China is working on telemetry in cascade stations in Panxi River and commissioning of the system is expected during the first half of 1985. The experience obtained from this project could be disseminated through the publication of research reports and direct site visits.

3. China is willing to organize a training course, for example on "low-cost civil engineering design" in 1986, with the preparation of teaching materials to be done with lecturing in conjunction with other experts from the Asia-Pacific region.

The inauguration of the Phase-II HRC building is planned for second half of 1986, and China is willing to host a "High-level Policy-Makers' Symposium" to coincide with this opening ceremony.

China supports the work of the RN-SHP Secretariat in the field of information; China is actively compiling data on her own SHP stations and experts. Furthermore, China can participate in consultation teams where required.

II. MALAYSIA

1. Recommendation on Priority Subjects for future RN-SHP Expert Group Meeting/Workshop

In the development of small/mini hydro power for a developing country in particular, the main aspect that should be considered would be whether the country is willing to develop the technology in line with the country's energy requirements as well as its capability in adapting foreign technologies to suit its priorities. Otherwise the venture might result in very expensive systems and may be a failure in the end, putting the country into debts unforeseen at the first instance. As such, there are several areas which should be considered when small/mini hydro is adopted by a country. Mini hydro development and technology can only be acquired through experience. From this statement, pilot and trial projects are necessary to gauge the ability of available manpower resources of the country in handling such projects, especially if large scale implementation is desired. In Peninsular Malaysia trial and pilot schemes have presented a new outlook into the issue. The areas that need to be studied in detail are the following:

a) Current civil designs in areas having heavy rainfall and high incidence of land slides

Particularly in Peninsular Malaysia, the tropical rain especially during the monsoon season spans over many months which can result in the hillside areas to be water logged. Landslides are frequent and these can have disastrous effects on the total mini hydropower station system. Landslides normally occur at strategic positions, e.g. cutting roads leading to power stations; landslides at pipelines anchor blocks; landslides at pole or tower position of transmission lines; landslides remote but at a higher level than the power stations and pipelines causing large rocks rolling down and damaging some parts of the system etc. The study in this area can mean:

i) Changes in designing of anchor blocks for pipelines e.g. having deep rooted pole structures rather than flat boxes.

ii) Ensuring proper anchoring of mini hydropower system, i.e. the pipelines and the power station anchored to solid immovable rock structures, if available.

iii) The building of specially designed non-metallized roads at specific locations with proper drainage.

iv) Studying the landslide phenomena and its reduction; say the planting of deep rooted trees at strategic positions.

The overall effect of this would mean that in putting up a mini hydro station a bird's eye view of the terrain, forest, fauna and geology have to be looked into from the mentioned problem.

b) Hydrology of tropical forest areas and the factors affecting these due to deforestation and the recovery of the total system thereafter.

Where logging activities take place, hydrology in tropical forest alters tremendously. Recovery of the affected area takes some time but due to its inherent nature, it can be considered rapid. The change in hydrology can be seen due to the initial clearing of the area and the subsequent growth of small plants. The total picture of the situation means on the onset of logging activity: large amount of silt; branches, logs and leaves are brought down by the river affecting the mini hydro system. Flood levels are high and may result in drowning of the power station. The high siltation shortens the life span in pipelines and turbines. The recovery of the system depends upon the type of plants that covers bare areas and this can possibly emphasize the proper replanting of trees in exposed areas of the forest.

c) The effects of mining and development causing sedimentation and high suspension in water system meant for mini hydro projects

In Peninsular Malaysia, mining industry is extremely active and mining can be in the form of opening large areas or can be digging up of river beds on small scale by illegal miners. The building of roads and open spaces simultaneously with deforestation have caused large amounts of sediments to appear in the water system. The abrasive nature of the products of these developments are disastrous in the mini hydro projects. Controlled mining is necessary to keep the water from being polluted. There is a need to look into the means of reducing sedimentation caused by such activities.

d) Methodology of transporting materials and equipment to site

Transporting materials and equipment to site has been a problem in this area especially during the rainy season. The terrain does not allow the use of vehicles at times and the heavily forested area makes it difficult to transport material by means of helicopters. As the cutting of trees is discouraged, methodologies have to be developed for transporting material and equipment into such areas. Excessive earth movements mixed with the tropical rain can be a hazard.

e) Construction methods using cable system

From experience, it was found that the best system of construction in this area is using cable systems for transporting pipes, cement, steel and all constructional material necessary at site. The cable system stretches from a convenient location of storage of material covering the total mini hydro system, i.e. from the weir to the power station. Methodologies have to be developed considering that every site has its own peculiarity and its contours and anchoring methods have to be developed individually. A standardized system can be created for all mini hydro sites.

f) Type and design of machinery to be used in implementation of projects and the minimum number of equipment that can be used in the construction

In putting up mini hydro stations the difficulty in transportation of materials to site means the need to design specific equipment for such system. The number of equipment used in the construction should be minimized and if implementation is to be carried out on a large scale, studies of this topic are necessary to cut down construction costs.

g) Training of manpower for constructional purposes

The training of manpower for constructional purposes is essential when working on a difficult terrain in the tropical jungle, as well as when trying to introduce a technology in these remote areas. The handling of tools and equipment in difficult areas with makeshift construction pads and dangerous situations calls for the need for such training.

Apart from normal training in constructional methods, the men should be trained for difficult terrain work as well. The training involves climbing, working suspended in mid-air, along cliffs, on river beds, etc.

h) Method of building roads to power station

The building of roads to mini hydropower stations is not easy due to the terrain and nature of land in this country. There is a lot of experience to be gathered from loggers who build their tracks that seem to have lasted for many years. The roads to the power stations have been thought to cover the minimum requirements only, are subjected to landslides and also the rapid growth of fauna can mean slippery and unreliable roads. The maintenance of such roads can be expensive and as such, the design of roads has to be looked into bearing in mind that the capital spent is small in order to place the project outside the economic constraint of the financing agency.

i) Fitting designs into the environment; minimizing blasting, cutting of trees and steps to be taken to avoid damage to pipelines from fallen trees

The environmental effect of cutting down trees and blasting of rocks is normally not called for as disturbances to the environment are highly undesirable in this country. Designs of mini hydro systems have to fit into the environment. The cutting of trees has to be avoided and damage to pipelines from fallen trees has to be looked into. The nature of a tree falling in the jungle is an unknown phenomena and can be caused by winds, animals or age. Falling trees close to pipelines seldom damage them, but those further away seem to have more effect. It can be deduced that the height and type of tree and its distance from the pipeline and power station has a strong bearing on the degree of damage that these trees can do. Minimizing the blasting is essential to cut down the security constraints of construction in such areas in this country.

j) Effect of flooding and generation of electricity while under flood conditions

In the event of flood occurring it is usually that the weirs and connecting intake area of the mini hydropower station is covered with water. The tailrace water level at the power station rises resulting in overall decrease in head available for power generation. Decrease in head results in inavailability of the power station to generate sufficient power and there may be vibrations and fluctuations in the overall system due to this. Power station foundations are subjected to severe errosion and backwater effect due to constriction of the river downstream from the tailrace. The operation of power station under flood condition needs to be studied as in Peninsular Malaysia flood occurs very frequently.

k) Effect of water hammer on pipelines

Water hammer on pipelines in mini hydro systems occur only when the power station machinery is subjected to sudden stoppage or due to a sudden closure of the main valves. Water hammer can also occur during the operation of the machine due to the inherent characteristics of the machinery. A study on the effect of water hammer on the pipelines and its solution is essential for the protection of the pipeline and the machinery. Each power station is peculiar in this aspect and means of correcting this phenomena is necessary in order to extend the life span of the mini hydro system.

l) Machinery and seed designs for manufacturing

In order to reduce costs, it is necessary for countries to manufacture their own turbines where possible. There is a need to produce seed designs as these form a basis for design or other sizes needed. The design of the machinery must take into consideration the capability of the country in terms of local manufacturing especially where precision is demanded. A venture in this area can have vast implications on the future of manufacturing in an undeveloped country.

m) Simplification of turbine governors of load ballast type and electronic types

Current types of governors, mechanical or electronic are complex in nature and requires skilled workmanship in developing them. There is a need to simplify such governors in order to reduce its cost, bearing in mind also that the degree of precision influences the standard of the electrical power generated. Hybrid designs are recommended and may be a solution to many areas of governor design.

n) Machine transportation, installation and commissioning

The transportation of machinery to mini hydro stations as well as its installation and commissioning demand certain skills. It is essential to ensure that this is correctly done, possibly through a system checklist and a guide manual of procedures in handling machinery, checking of levels, dynamic testing, etc. Some degree of training is required in this area especially where larger systems are being installed. The safety aspects of machinery training installation and commissioning must be stressed to avoid mishaps to personnel involved and to ensure long life to turbine and generating machinery. Simplification of the total machinery installation by having the whole power station in preassembled containers is the target. This can be an interesting aspect for a study.

o) Fault of generating systems and their protection methods. Computerized control of machine operation, remote sensing for remote operation

In the long run, mini hydro generating systems can have faults and in such cases the protection system must be adequate to prevent damage. Where a large number of mini hydropower stations have been established, computerized control of machine operation may be necessary especially in the area of remote sensing for remote operation. This is to cut down manpower as well as to increase reliability of centralized control of these power stations as their contribution has a considerable effect on the grid system.

p) Transmission and distribution designs, grid connections and reliabilty of systems

The transmission and distribution of the electrical energy where the mini hydro station is connected to the grid can determine the reliability of the total system. Where a large number of mini hydro stations are connected to the grid and they represent considerable value of power input to the grid, the sum effect of these stations to the grid system is large and must be studied from total power generation point of view. Assessment must be made on the reliability of the system, the stability of the system, the effect of faults in large power stations on the operation of these small stations, the effect of voltage swings, etc.

q) Social and economic effect of small/mini hydro systems

On the establishment of mini hydropower generating system the social and economic effect of the benefitting rural population must be taken into account in order to quantify what was earlier considered as intangibles contributed by such power stations. The social and economic studies will determine the rate of growth of the area, the contribution of the generating station as a nucleus for development, as well as the future projections in order to cater for demands of the area. The implication of such a system for the rural population must be considered.

r) Use of tailrace water for irrigation and drinking water

Water available from mini hydropower station, i.e. from the tailrace can be used for irrigation or drinking water for the rural population. In each instance, a study should be done especially on the design and type of water collecting intakes for these purposes. Methodologies to effect these systems must be considered in order to obtain the maximum benefit for the rural area as well as minimizing its effect on power generation by the mini hydro stations.

s) Pricing of electrical energy when connected to the grid for economic/financial evaluation purposes

In evaluating a mini hydro station, the pricing of electrical energy must be considered for the economic and financial evaluation of the

system to determine availability of the projects and the degree to which the project can recover capital investments injected into it. The pricing of electrical energy is normally inadequately done especially in small hydro stations or run-of-river types when these are compared to major hydro installations. Pricing of the electrical energy transmitted to the grid must be looked into in order to testify that these stations prove to be economical. Methodologies and approach of the pricing system should be laid out so that each country can evaluate its mini hydro stations, as well as to determine the size of the loan needed from international banks. Proper pricing should also ensure that the benefits obtained are real and will not unnecessarily put a country into debts which it cannot afford. An international agreement on this matter and its approach is necessary. International banks must be convinced of the approach to pricing of the electrical energy generated by mini hydropower stations.

t) The effect of mini hydro on agricultural development upstream on ungazetted catchment area

Having installed the mini hydro stations, it is expected that the rural population would increase activities to enhance living standards. There is a possibility that increased agricultural activities will result in development of upstream, especially ungazetted catchment areas. The social and economic effect including the effect on the power stations must be looked into to ensure certain possibilities to be included. In certain developing countries such an incident may not be avoidable, but steps must be taken to ensure that minimum effect is seen on mini hydro stations already built. There may be a need to gazette catchment areas but there is also a need for the rural population to prosper and feed themselves by the use of these areas discriminatingly to ensure that the total ecology and well being of the catchment areas and the mini hydropower station is safe from undesirable effects.

u) Types of new mini hydro systems and research work into these areas

Innovation and new designs are necessary to produce machinery and systems that can harvest water energy to the maximum. Current designs are limited and can only harvest water designs above a certain head. Research must be done to look into these areas of harvesting water

energy to the lowest level and at the highest efficiency. Different turbine designs and new concepts have to be considered, as not all the terrain along a river have adequate potential head. Energy in free flowing rivers with no head are enormous but cannot be harvested at the present moment. Efforts have been made to create new engines but insufficient enthusiasm is currently predominant. The aim is to increase the efficiency of the total system with maximum harvest from these rivers.

2. Priority areas for Joint Research Project

a) Study into the use and manufacture of the crossflow or Banki turbine for medium and low head mini hydropower stations

The crossflow or Banki water turbine has been known for many years to be a versatile turbine, easily manufactured, but unfortunately has a relatively low efficiency when compared to the Francis turbine or Pelton wheel. It is known that only one manufacturer has been able to raise the efficiency of such a turbine to value comparable to that of the Francis. This means that it is possible to develop a crossflow turbine that has a high efficiency. The ability of the crossflow turbine to function over a large range of heads as well as over a wide range of water flow, makes the turbine an essential item in the development of mini hydro technology in the developing countries. The fact that the turbine has minimum casting requirements and can be easily fabricated in small workshops makes it more reasonable for developing countries to venture into the manufacture of this type of turbine. Unfortunately, little work has been carried out by institutions on the turbine other than those done by private enterprises. It is therefore suggested that work be considered in this area to take advantage of the inherent simplicity of the machinery and its capabilities as a mini hydro turbine. Malaysia has acquired the designs of the basic turbine from OLADE (Latin American Energy Development Organization) and is in the process of developing the turbine for use in this country.

b) Joint research into the development of turgo impulse turbine for medium and high head designs

The turgo impulse turbine is a hybrid and links the opoerational field of the Francis turbine and the Pelton Wheel. Castings or fabricated turgo impulse wheel are easily made and this turbine can be developed easily for use in developing countries. The fact that it covers a large range of operation from that of the crossflow turbine to fringe areas of the Pelton Wheel operational chart gives this turbine an advantage over the Francis turbine. The complexity of the Francis turbine gives the turgo impulse wheel a definite edge over it. Development of this particular turbine therefore completes the scenario of development required in the turbine area.

c) Research into governing systems for mini hydro stations that includes load distribution, ballast load system

The governing systems for mini hydropower machinery determines the reliability and standard supply available to the rural consumer. Currently developing governors are based on complex design and there is a need to develop governors either mechanical, electronic or hybrid types for the mini hydro turbine. Research into this area can be very fruitful if steps are taken to use alternative parts from tractors and motor cars as parts in the governor design. An alternate and appropriate design using available parts would mean low cost development programme for developing countries in this context. Maximum use of these parts should be considered bearing in mind that these parts are available at low cost due to mass production. The use of electronics in the governing system should be minimized where possible as spare parts become the issue in the long run.

d) Research into the systems for energy utilization and use in rural areas such as hot water system, refrigeration systems, etc.

The generation of electrical energy in the rural area would not be helpful to the rural consumer if the energy is limited in use for lighting, radio and T.V. only. As a nucleus of development mini hydro

energy must be used wisely in a manner to augment the progress of the rural sector. Research into the area of energy utilization and use in the rural area for hot water system, refrigeration, electrolytic use in agricultural, industrial and rural sectors must be considered.

e) Use of water resistance for testing of mini hydro turbines

The testing of water turbines requires loads to be varied over a large range of the water turbine generating systems loading. The problem of transportation of large banks of resistors for commissioning makes it necessary to use water as a variable resistance representing the loads for testing purposes. Research into the use of water as well as the design of the rigs to create water resistance and the safety aspects can be looked into in order to minimize transportation problems. Current turnkey projects in the Malaysian mini hydro programme makes use of water resistance for loading purposes and it has been found that there is a need to better design and increase safety features.

f) The methods of supply to rural villages using battery charger systems

For certain developing countries having populated areas very remote from town centres but where a small hydro station can be put up, the output from the system may not be able to cater for the number of potential consumers. As such, a method of supplying these areas using the battery charger systems (currently being developed in Malaysia) is being considered. The system makes use of the concept of storage of electrical energy in batteries. The advantage of this system is the low maximum demand on the generating station as well as its ability to function at long lines at low voltages upto a distance of 16 kilometers. This is an interesting area for research which can mean supply of electrical energy to the rural area for small generating systems, similar to the water supply system where each household maintains a water tank for storage purposes. This method makes possible the combination of a micro hydro system with solar and or wind energy combination or even with a biogas generator. A total integrated system can be adapted where the battery charger system is introduced.

g) Study in maximizing the harvesting of water energy

In a large number of cases in Malaysia where the rural sector has been developed there exist rivers with very good potential for energy harvesting. As these rivers are close to the grid there is a need to study the means of maximizing the harvesting of water energy and transmitting it to the national grid. Such a mini hydro station normally employs induction machines and turbines with no governors. The total concept of the mini hydro generating station must be evaluated and researched into to ensure optimization in terms of capital invested to the project.

3. Decentralization of RN-SHP Activities

The number of appropriate projects can be entrusted to member countries and, in particular, Malaysia could carry out the following:

i) Hybrid governor system, electrical/mechanical

It is thought that the hybrid governor consisting of a load controller system and a slow speed mechanical governor would be useful in reducing the cost of the governor system. In areas where there is insufficient water, the turbines would be subjected to peculiar operating conditions when using a load controller. The pipeline may be subjected to fluctuation of the head. It is essential that water must remain at a certain minimum level at the intake to ensure that the pipe is filled with water at all times. The hybrid governor system operates in similar manner to the load controller but the ballast load resistance banks should consist of a short time load resistances able to absorb heat from full load dumping by the generator for a period of not more than (say) five minutes. This temporary load dumping means that the mechanical governor will be able to operate within this period to adjust the machinery inlet valve to the appropriate position. Little demand is made on mechanical unit in terms of time response, as well as the load resistor banks need not be large as it functions only as a short operating time device.

ii) Micro-processor control of power station operation and system protection

The country is looking forward to building a large number of mini hydro stations for both rural electrification and energy harvesting aspects. Micro-processor control of power system operation and system protection would be essential as it is foreseen in the future that there will be a reduction in manpower operating these plants. There is also a need for centralized control for a group of plants within the vicinity of a control centre. Coupled to this would be the need to conduct research in terms of data, transmission and the remote control of small hydro station to ensure optimum operation of these stations. Low cost solutions to these systems are necessary and need to be looked into.

iii) Use of water resistance for testing of mini hydro turbines

As mentioned earlier under the same title this subject shall be of interest to many countries as it is the means of eliminating the need for resistance banks for load commissioning of the mini hydro generating output. The important aspects to be seen in this areas is the use of high voltage (say 11kV) on the resistance banks can mean excluding heavy equipment to site. The available water at the tailrace or the river bed makes this system suitable for commissioning purposes. The research project should include building the rigs, as well as determining the configuration and the material to be used. A certain desired standard can be achieved from this equipment.

iv) Development of turbines for local manufacture

This covers projects that can be entrusted to member countries, as mentioned earlier, as the need to manufacture turbines in order to cut down costs of such an equipment in the developing countries. In particular, the OLADE design should be considered as a basis for starting.

III. NEPAL

1. Priority subjects

The Small Hydel Development Board (SHDB) of Nepal, with its ten years of experience in SHP development has identified the following needs and priority subject areas and projects, which are also of regional significance:

i) Establish hydrological analysis method suitable for ungauged streams for SHP generation in Nepal

Most of the SHP sites in Nepal are located in the very remote part of the country and to establish and manage proper (permanent) gauging station in all these small streams is practically impossible. However, without proper hydrological studies, estimates of flow in the river will continue to be in error with the consequent high cost of over- or under-designed hydropower projects.

Therefore, SHDB believes an analytical method should be worked out to obtain the hydrological data from these ungauged and partially gauged steams. The analytical method if developed properly could also be utilized by other countries within and outside the ESCAP region with similar conditions.

ii) Rationalized design for SHP civil works (Design manual)

SHDB has undertaken a number of SHP projects in different hilly areas of the country. The demand for construction of such projects are increasing quite rapidly. SHDB with its limited technical manpower resources is facing a tremendous task to cope with the increasing number of investigatory and design works.

Therefore, if there are several SHP projects at hand, the design could be rationalized and relatively inexperienced engineer and other manpower could be trained and used in this field.

A rationalized design is one in which design principle and construction details are standardized but the overall sizing is adopted to match the site. Unlike diesel plants, SHP plants cannot be mass produced, each must be designed individually as each site is quite unique and has its own peculiar problems. Design rationalization will reduce job repetition and consequently utilization of the scarce technical manpower can be maximized. SHDB considers this subject to be also of regional significance.

iii) Utilization of computer facilities for SHP development

For the ever increasing tasks of SHDB, the benefits deriving from the use of computer facilities are quite obvious. Besides storing a number of different information, it can also help in design computation.

Recently, a research proposal on optimum design system for SHP projects using the computer programme has been submitted to SHDB by a local consultant (IDS). SHDB is seriously considering the application of computer facilities, especially to also develop point ii) above, i.e. a design manual.

iv) To improve the present technical capability of local Electro-Mechanical Equipment Manufacturers

At the moment, only few turbines upto 100 KW capacity have been manufactured locally. So far, only crossflow turbines have been tested with the imported generator. Several improvements are required in this field. Collaboration with experienced foreign manufacturers could be very useful.

v) To develop economic criteria for selection of most feasible SHP generation - Development of Master Plan for SHP in Nepal

SHDB has certain criteria and priority for the selection and development of SHP projects in Nepal. But after electrification of a few villages, the demand for electricity in a large number of villages and settlements in the remote, hilly areas of Nepal are

growing very fast. Taking this into account, with the existence of large number of perennial streams in the mountains, the development of a Master Plan for SHP in Nepal seems to be an urgent necessity.

2. Priority subject areas for joint/co-operative research projects

Some of the activities and items mentioned under section 1. can be incorporated in this section 2. However, some of the joint/co-operative research projects are briefly mentioned below:

i) Electronic Load Controller - ELC

Local Manufacturers in Nepal are producing turbines of less than 100KW capacity, with the imported generators. However, due to high cost, the electromechanical equipment supplied by local manufacturers generally do not include any automatic governor. In Nepal the delicencing policy of SHP projects up to 100KW has encouraged village community and private entrepreneurs to come forward with more mini hydro projects.
However, in order to implement such programme on a large-scale, it would require cheap as well as reliable electromechanical system.

In this context, the research project on Electronic Load Controller (ELC), undertaken by the HRC, could be quite useful in Nepal. The research project could be further developed in co-operation with HRC and SHDB.

ii) Maximum utilization of local materials - reduction of cement use

As mentioned earlier, most of the SHP projects in Nepal are located in the very remote part of the country where road transportation facilities are not available. Therefore, the transportation cost of construction materials, which are not available at the site is very high. For example, the transportation cost of cement at some sites are 7 to 8 times higher than the actual cement price at the factory.

Therefore, joint research programme could be worked out on the design of hydraulic structure for SHP, where the use of cement can be minimized and the use of local materials can be maximized.

iii) Optimum design systems for SHP projects

SHDB, at the moment, is considering a research project proposal for optimum design systems for SHP project, submitted by a local consultant (IDS).

The primary objective of the proposed research is to improve the technical and economic efficiency of SHP projects by developing a computer-based design system.

The estimated total budget for this research project is about US$100,000 for three-year period. However, the cost and total time could be reduced with the further review of the proposal and availability of specialist manpower in this field.
The most immediate benefit of this research will be the savings in the cost of design and construction of SHP projects. It will provide considerable savings of scarce technical manpower and project time; and also improve technical efficiency of facilitating rational site selection and quality control.

At this moment, this research proposal has not been implemented due to financial and manpower constraints. SHDB considers this research proposal useful not only for Nepal, but with some modifications, it can equally be applied to other countries from the region as well. Therefore, SHDB suggests that this be taken up as a joint/co-operative research project.

3. Decentralization of RN-SHP activities

i) A Seminar/Workshop could be organized on Design of Hydraulic Structure for SHP projects in 1986 in Nepal, provided that financial resources can be secured.

ii) The SHDB would welcome any activity in the future to promote the decentralization of SHP programme.

IV. PHILIPPINES

1. Priority subjects

i) Expert Group Meetings

a) Assessment of prior accomplishments and present programme

b) Plans and programme for the future (e.g. establishment of a special school for hydropower planning, engineering, etc.)

c) Funding requirement and sources.

ii) Workshops and Training Courses

The Second Meeting of the ASEAN Working Group on Co-operation in Micro/Mini-hydro Development identified the priority areas for its training programme as follows:

a) Technical Planning

- Hydrology
  - Correlation methods
  - Appropriate flow measuring techniques

- Geotechnics (modern)
  - Latest developments in low-cost methods applicable to micro/mini-hydro development.

- Socio-economic aspects
  - Techniques on the determination of tangible and intangible benefits.

- Feasibility study
  - Development of a simplified and standardized format to meet the requirements for decision-making purposes.

b) Construction

- Engineering design
  - Low-cost, simple design utilizing to the maximum content possible locally available materials.
  - Recommendations for the standardization of civil and electro-mechnical works components.
- Contract administration
  - Engineering and supervision
  - Construction
  - Procurement matters
- Local manufacturing capability

c) Management

- Development of effective management systems for micro/mini-hydro programmes.
- Operation and maintenance.

The Philippines feels there is also a need for training on environmental impact assessment and mitigation. Planners and decision makers should be able to identify the critical areas which may be adversely affected by the mini-hydro project and (a) see if something can be done to remedy the effects; and (b) decide whether to push through with the project or not.

2. Priority Subject Areas for Joint Co-operative "Research" Projects

i) Standardization of civil and electro-mechanical works design. The Philippines is currently working on this project, in co-operation with its consultants.

ii) Hydrology - setting up of stream gaging stations; gathering of rainfall and precipitation data; and use of correlation method.

iii) Geology - sub-surface exploration, particularly for the dam, intake, headrace and power plant locations; erosion protection and drainage design for headrace, penstock and other structures.

iv) Diversion Dam - types of dam and criteria for the type of gate to be used.

v) Intake Structure - sediment transport and siltation (maintenance).

vi) Headrace - selection of type of headrace (open or close; steel, concrete or fiberglass).

vii) Surge Protection - design of surge pressure protection for forebay, surge shaft and surge tank.

viii) Penstock - type/material to be used for penstock (steel or fiberglass, etc.).

ix) Power Plant - economical design of power plant using locally available material.

x) Equipment Selection - type and size of mini-hydro equipment units to be used to maximize site potential based on latest performance data.

3. Areas and Types of Activities where the Philippines could take the Lead for Organizing Projects

i) Training

The first and second training workshops on SHP for Asia-Pacific region were held in Hangzhou, People's Republic of China in 1983 and 1984, respectively. A total of twenty six (26) participants from nine (9) countries attended the two (2) training workshops.

Decentralization of training activities may allow to conduct more training courses and workshops in a year. A larger number of people can participate. Some ways in which training activities can be decentralized are briefly discussed below:

a) Holding of training courses outside China.

b) Grouping the member countries by region (or according to certain criteria such as level of SHP technology used, status of SHP programme, etc.); and holding the training courses by region, instead of having all the member-countries participate in every training. This will be more effective since the discussions and examples will focus on areas/problems which are common to the group/region.

c) Establishment of training units, either government agencies or specified groups, in selected member-countries to organize training workshops. One training unit per region/group may be organized which will take charge of the training activities of the region. Training courses may be conducted in different regions/groups simultaneously; they may also be conducted from one region to another (which may be more economical). For example, a group of lecturers may conduct a course in region A. This may be composed of foreign lecturers and experts from region A. The course can be revised to suit the conditions of region B and experts (from region B) can be invited as resource persons.

d) Sub-contracting the training courses to government utilities or specialized groups of member-countries. They may be invited to submit proposals on specific topics. UNIDO/HRC can evaluate the proposal and decide who will conduct the course. The courses can be implemented in the same manner as c) above.

ii) Video Tapes on SHP

HRC has made nine (9) video tapes of its activities for the past years. These tapes have to be reviewed first before work on other tapes can be started. Some scenes/shots from these tapes can be used in future projects. As discussed by the Consultation Mission during its visit to the Philippines, a group of video and SHP experts may be invited to meet and discuss the preparation of video tapes. This group can determine the coverage, the number of tapes, objectives and other criteria/guidelines for the video tapes. Implementation can be done in two ways:

a) Given the guidelines set up during the meeting, HRC can implement the project, hiring video experts as needed. This can be done in co-operation with countries that will be covered in making the tapes.

b) Sub-contract the making of tapes to a member-country or a group of video/SHP experts.

It is recommended that at least three (3) tapes be done at a time. Some shots needed by three (3) films can be taken in the same sites, hence, minimizing travel cost and time.

4. Suggestions to Facilitate the Implementation of Information Exchange among Member Countries

The ASEAN Working Group on Micro/Mini-Hydro Development has set up the MHINEX - Micro/Mini-Hydro Information Exchange System, where member countries are expected to submit quarterly, various data/information

agreed upon during its second meeting. MHINEX (for ASEAN) and other regional organizations can be tapped by HRC to send contributions or other data it needs for its publications. This will entail less time and cost, and may be done more efficiently.

During the meetings (senior experts, TAG, etc.) the participants may agree to submit certain data/information that HRC needs, and the frequency of submittals. A deadline can also be set for regular publications. For example, members should know when they should submit their contribution if they want it to be included in the first quarter issue of the newsletter.

V. SRI LANKA

1. Priority Subjects

The establishment of the Regional Network for Small Hydro Power (RN-SHP) in itself underlines the necessity for co-operation and dissemination of information for development in our region and the respective countries where small hydropower activities are concerned. The vital areas of dissemination of information could include the following:

i) Emphasis on training courses to develop human resources.
ii) Manufacturers and suppliers of SHP equipment in the region.
iii) Encouragement and incentives for the publication of all R&D activities already accomplished in the region.

i) Education and Training Needs:

Education and training needs stem from the national goal objectives and aspirations and the scope of activities that have to be undertaken to realise these goals and objectives. Such activities [illegible] parameters for consideration with regard to the mini-hydro power development would encompass:

- Identification of potential sites
- Collection and analysis of hydrological topological and geological data
- Power and energy potential evaluation
- Diversion dams and storage facilities
- Intake structures and water conveyance systems
- Penstocks and surge tanks
- Turbines and generators
- Speed, load and voltage control equipment and protective gear
- Power house and anciliary equipment
- Energy supply and demand features and load dispatching equipment
- Cost benefit and other economic considerations of financing mechanisms
- Construction management
- Operation, maintenance, trouble shooting and overhauling
- Social and environmental aspects

ii) Manufacturers and Suppliers of SHP Equipment

The feeling prevalent among most of our planners which presumably is still inherited by us from our colonial rulers, is that "the best performing equipment can only be imported from developed countries". This is not only a myth but hazardous for the successful implementation of an effective SHP development project. It would be true to say that this may have been the case some decades back when the local industries in this region were in their infancy. There is sufficient evidence to believe that at present local manufacturing industry of small machinery has reached a level of maturity to be able to well compete with the high cost, high technology equipment from the developed countries. It would be unwise to state here that this equipment is redundant but the fact should be emphasized that each piece of equipment should be evaluated on its cost effectiveness.

The above should always be complimented with a proper alternative suggestion of encouragement, provision of incentives and popularisation of local machinery. Without such scheme to popularize, advertise and market the SHP equipment that could be produced locally the results may be discouraging. Hence the necessity for a proper scheme to popularize, advertise and market this equipment is inevitable.

Popularization could be achieved by demonstration. This could be done by Government sponsored projects or projects sponsored by an international funding agency, always using well proven technologies with simple, unsophisticated parts that could easily be substituted or manufactured by a local craftsman.

The advertising and marketing facilities would evolve with the popularization effort and this could further be supported by distribution of brochures, news bulletins and popular magazines.

iii) Dissemination of R&D Efforts

Much effort is being wasted in this aspect mainly by duplicating the work carried out already by established organizations geared for these activities. On the other hand less R&D work is being undertaken in certain areas of SHP development such as cost reduction techniques, effective technologies and adaptability of already existing technologies.

The other aspect of R&D activities in the region should be to encourage the researchers to do much wanted and relevant research work and proper dissemination of this work hence it is very important that all research organizations be identified firstly under the RN-SHP Sub-Focal Points then also under the RN-SHP itself. It would be a worthwhile effort to co-ordinate these activities both at national and at regional levels and all the activities be properly documented so as to give wide publicity to such important activities and to encourage other users in the region of the facility to avail themselves with the latest technique and technologies developed.

2. Joint Research Project

High priority area in the region could be classified as follows:

a) Simulation of climatological condition
b) Remote controlled and unattended operations
c) System cost optimisation of SHP

The above three priority areas are to a great extent interrelated to each other and need greater attention in our future SHP development activities.

a) Simulation of climatological condition

This is one of the most unreliable parameters of the design of a proper SHP project but, nevertheless, one of the most important in the whole exercise of the design. In almost all the cases of sites selected for SHP development it has been observed that the rainfall patterns, river-flow data are very scarce and unreliable. Nevertheless the designs will have to adopt some criteria of flow duration curves and other required data. Hence the need for the development of appropriate mathematical models or empirical relations is very essential. The development of such a programme has to be given much needed co-ordination by our eminent researchers in the region both in the organized establishments and in the universities offering hydrology as subjects.

b) Remote controlling and unattended operations

It is our experience that many SHP projects fail to materialize for the lack of available trained personnel to handle such projects and also for operation and maintenance of these plants. Many of the plants now abandoned or ruined are due to this fact. Therefore, it will be a worthwhile exercise to focus our attention on remote

control facilities. Taking advantage of the fact that these SHP schemes could be connected to the national grid or could form themselves into local mini grids, the possibility of remote controlling and centralized operation could be considered.

Telemetering and remote controlling has been in operation in our countries for sufficient length of time that the experience gained and the expertise developed is available. It would be only necessary to develop clusters of SHP projects to form themselves to be centrally operated by a few skilled and trained personnel, thus eliminating numerous problems associated with the lack of trained personnel who are in most cases unwilling to serve in remote areas. It should also be mentioned here the advantage of eliminating all associated overheads involved with staffing a manned power plant.

c) System cost optimisation of SHP

This is one of the least addressed subjects in the field of research in our region. It has always been the case for someone other than the designer to evaluate the project where cost effectiveness is concerned mainly for funding purposes. The need for closer understanding of the cost vs. the design parameters is a prerequisite for cost optimisation of such a project. Ready reckonners and computer models should be developed and in cases where it is already developed it should be modified wherever possible to correlate the design parameters of the system with the cost and economic parameters.

The expertise available in our countries could be well utilised for the development of such econometric models to run on micro processors or results of such runs to be made available to our designers as ready reckonners.

3. Areas and Types of Activities where Sri Lanka could take the Lead for Organizing Projects

Several projects which could be carried out within the country by taking a lead role could be identified as follows:-

a) To act as a focal point for information dissemination;
b) To scrutinize and forward suitable candidates for proper training;
c) To co-ordinate activities of fellowship recipients;
d) Organisation of seminars, meetings and workshops on SHP;
e) Monitoring of hardware development effort;
f) Market penetration studies.

VI. THAILAND

1. Priority Subjects

The meetings and workshops on small hydropower organized previously could be considered as satisfactory. However, subjects dealt with in those meetings were oriented towards fundamental knowledge of small hydro development. They are excellent in their own context but their contribution to the cost reduction of the project is questionable.

With this concept in view, priority subjects for future expert group meeting, workshop and training courses are thus proposed as follows:

i) Expert Group Meeting

Subject — Feasibility study

Objective — To identify various drawbacks and inappropriate criteria and methodology currently employed in the feasibility study of small-scale hydro and formulate a new internationally recognized standard manual, specifically tailored for the feasibility study of small-scale hydro schemes.

Participants — Experts from member countries as well as from international and United Nations Organizations and from technical and financial sectors.

Justification — Feasibility study is the decisive factor for the existence of project and it is mandatory. Since small-scale hydro is rather a newly emerging area, the criteria and methodology currently employed by the financial institutions was adopted from the conventional one used for the feasibility study of major hydro. They are inappropriate and consume substantial time and money, which small-scale hydro cannot afford. In addition they are oriented towards financial benefits rather than economic. As a result many projects good for rural development were discarded simply because their overwhelming intangible benefits could not be counted in the evaluation and the projects thus became infeasible. A new criteria and methodology specifically tailored for small-scale hydro have to be innovated.

ii) Workshop

Subject — Design and construction of low-cost civil works

Objective — To exchange and compile information and experience in the design and construction of low-cost civil works in various countries.

Participants — Experts from implementing agencies in small-scale hydro from member countries and also invited experts from outside the region.

Justification — The major cost of the small-scale hydro is the civil works and in some cases occupies as much as two-thirds of the project costs. The simplified standard design and construction approach to alleviate the cost of civil work will help to increase the economic viability of the small-scale hydro projects.

iii) Training Courses

a) Subject — Civil Works Design

Objective — To train junior civil engineers in the design of low-cost civil works.

Trainees — Junior civil engineers from the region.

Justification — Civil works is the major investment portion of the small-scale hydro. However, the civil work can be designed and constructed by local engineers at reasonable cost providing that they have the appropriate information and experience. Unlike the mechanical and electrical counterparts, the knowledge of civil design existed in all countries of the region. In addition, their acquaintance with local materials available and site conditions offer merits of their work. In many cases, especially for small hydro in remote areas, these qualifications have evidently proved to be of great advantages to the design of low-cost civil works. This course will broaden the horizon of these engineers and thus strengthen their capabilities in this field.

b) Subject — Small Propeller Turbine Design

Objective — To train mechanical engineers in the design of small propeller turbine for irrigation canal.

Trainees — Mechanical engineers

Justification — In rural areas of many countries in this region, the governments have constructed many small weirs and canals for irrigation. These weirs and canal drops offer excellent small hydro potentials for electricity generation or mechanical power that the farmers in the vicinities can utilize. Yet, these potentials have not been harnessed, its constraint is the costly generating equipment, particularly the turbine. Therefore the know-how of small propeller turbine design, probably in the range of 1 to 5

kilowatts, and exchange of information on locally manufactured low-cost propeller turbine in order to increase the productivity and improve the quality of life of a large sector of population will be greatly beneficial to the rural poor.

2. Priority Subject Areas for Joint/Co-operative Research Projects

In hydro-electric generation it is vital that the frequency has to be constantly maintained no matter how the load varies. Normally, hydraulic or electro-hydraulic governor is used for controlling the speed. This type of governor required sophistication in design, precision in manufacturing and highly trained personnel to adjust and maintain. Therefore, they are supplied by only a handful of manufacturers around the world, and of course, at a very high price. The electronic load controller recently developed and introduced to the market opened the new era of low-cost, but near free maintenance governor.

In our experience as the user and manufacturer of the load controller under the license from U.K. for over five years, the load controller proved its claim. However, its limitation in capacity (not over 100 kW) and in application (consistent amount of water discharge)and the problem of heat dissipation of the dummy load together with its performance that does not allow synchronization with other machines made its application confined to the small, isolated run off the river with high discharge hydro scheme. Nevertheless, its concept and performance are quite impressive. In addition its low-cost makes it challenging to explore into the possibilities of modifying it for flow controlled application. In this new application the electronic part will function as a frequency sensor. The change in frequency as the result of the load variation will transmit the electric command signal to drive the gear motor coupled to the flow control valve which will increase or decrease the flow according to the requirement. Thus the turbine speed will be constantly maintained.

At present, the National Energy Administration is developing this type of governor. The performance of the prototype simulated in the laboratory was encouraging and actual field test will be carried out soon. However, the perfection of its performance requires further research work. In this regard, Thailand proposes the development of this type of governor as the priority subject area for joint and co-operative research projects.

3. Areas and Type of Activities where Thailand could take the Lead for Organizing Decentralized Projects, Subject to Availability of Financial Support

The area of activities that Thailand can propose to take the lead for organizing decentralized projects is on-site training course on the co-operative approach in the management of construction and operation of small hydro for rural villages.

In Thailand, many rural villages in remote areas, have enjoyed better quality of lives through electricity from small decentralized hydro power developed and managed by the villages themselves. In each project the villages will form among themselves a co-operative in joint venture with the Government to construct small hydropower stations in their vicinity. The villages contribute free labour and free local materials. The Government provides the rest including generating equipment as well as technical assistance. The contribution from two sectors will be converted to shares which will be held by all participants. The revenue from the electricity will be shared among the shareholders. With this approach the Government can reduce the investment on rural electrification and allocate the burden on the operation and maintenance on remote decentralized stations. The villagers on the other hand, will benefit from the increase of productivity and enjoy better living conditions through electricity and co-operative benefits.

This approach can be duplicated in every country in the region providing that the technique of management and the will of people to co-operate exists. Thailand proposes to offer on-site training course in this know-how to the countries of the region, subject to availability of supporting funding will be made available from the UN organizations.

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ESCAP Regional Energy Development Programme (REDP)
Regional Network for Small Hydropower (RN-SHP)

Technical Advisory Group (TAG)
First Meeting

Hangzhou, China, 11 - 13 December 1984

REPORT*

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Abbreviations

ASEAN	Association for South-East Asian Nations
ELC	Electronic Load Controller
ESCAP	Economic and Social Commission for Asia and the Pacific
HRC	Hangzhou Regional Centre
IDS	Integrated Development Systems
INTIB	Industrial and Technological Information Bank
ITDG	Intermediate Technology Development Group
MHINEX	Micro/Mini-Hydro Information Exchange System
OLADE	Latin American Energy Development Organization
REDP	Regional Energy Development Programme
RN-SHP	Regional Network for Small Hydropower
R+D	Research and Development
SHDB	Small Hydel Development Board
SHP	Small Hydropower
TAG	Technical Advisory Group
TCDC	Technical Co-operation among Developing Countries
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization

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I. RECOMMENDATIONS

(Agenda Item 9)

1. The Technical Advisory Group expressed its satisfaction with the work carried out during 1982/83/84 under the Regional Network for Small Hydropower (RN-SHP), and the efforts made by the Hangzhou Regional Centre - Asia + Pacific - (HRC), acting as the Interim Secretariat of the RN-SHP, in organizing and implementing the work programme in spite of the severe financial constraints.

2. The TAG recommends reallocation of presently available funds under projects RAS/84/001 and RAS/80/033, to better reflect and respond to the priority needs of the member countries. Accordingly, based upon a list of priority topics compiled for that purpose, the RN-SHP 1985/1986 programme of activities was reformed and endorsed as per Table 2, i.e. US$190,500 for 1985 and US$82,000 for 1986.

3. The TAG recommends that with the co-operation of national focal points, UNIDO initiate necessary action to formulate and/or finalize project documents/project concept sheets, and present them to potential donor countries and solicit, on behalf of RN-SHP, the needed support for identified priority projects for which no funds could be made available from existing resources in hand. Towards this end, the TAG recommends that member national focal points, especially those that have been selected as participating countries for the projects, provide the necessary support to expedite UNIDO's task.

4. The TAG recommends that appropriate measures and a mechanism be worked out to communicate regularly to potential donor countries and organizations, information on priority projects and programmes of common interest and significance to the member countries, in order to enable implementation of the work programme over and above the financial resources made available through the REDP and other UNDP/UN sources.

5. In order to attain a reasonable level of activity-implementation under the RN-SHP, the TAG recommends that part of the project activities be decentralized so that the preparation of documentation, organization of activities as well as the bearing of hosting cost could be appropriately shared among the participating member countries.

6. After reconfirming that the RN-SHP consultation missions were extremely useful in establishing contacts and strengthening Network activities, the TAG recommends that provided sufficient resources could be secured, similar missions should be carried out more often, possibly on an annual basis. In this respect, the TAG further recommends that such missions might include representatives from selected participating member countries so that the lines of contact could also be expanded horizontally between and among the member countries. Subject to availability of funds, bilateral consultative missions might also be organized in the future.

7. The TAG strongly recommends that the REDP Senior Co-ordinator urge the member countries who had not yet nominated sub-focal points for SHP, to take timely actions for such nominations in order not to disturb the effective functioning of the co-operative arrangements within the framework of the RN-SHP.

8. The TAG recommends that only those member countries who have nominated their sub-focal points for SHP be invited to attend the second TAG meeting in 1985, in Manila/Philippines.

9. The TAG recommends that the TAG meetings should be opened to selected donor agencies who would be participating fully in the discussions as Co-operate Members, but would have no voting rights at the meetings.

10. The TAG recommends that in view of the importance of convening the TAG meetings annually and the limited resources available for the TAG meetings, the funds should be used only to finance international travel of TAG members, while the DSA would be contributed by respective governments.

11. The TAG recommends that UNIDO be requested to explore with the Project Manager of the Pacific Energy Development Programme (PEDP) the possibility of securing similar support as provided by the REDP to permit Pacific participating member countries to attend future TAG meetings, starting from the second TAG meeting in 1985.

II. INTRODUCTION

Background

12. In reviewing the energy situation in developing countries in relation to their industrialization process, the subject of new and renewable sources of energy has been recognized to be of major importance. This in fact was confirmed by the United Nations Conference on New and Renewable Sources of Energy, held in August 1981, in Nairobi, Kenya, as well as by the High-level Expert Group on Energy and Industrialization, Preparatory to the Fourth General Conference of UNIDO, held in Oslo, Norway, from 29 August to 3 September 1983.

13. Within the field of new and renewable sources of energy, small hydropower was identified as being of major significance in connection with the supply of electric power for industrial application in remote and isolated rural areas not covered by the national grid network. This potential was recognized earlier by UNIDO and ESCAP which jointly organized in September 1979 the First Expert Group Workshop on Mini Hydropower Generation in Kathmandu, Nepal. A Second Workshop combined with a study tour followed in 1980, at Hangzhou, People's Republic of China, and Manila, The Philippines when the People's Republic of China, in response to the recommendations of the first and second mini hydropower meetings, proposed to establish a Regional Centre for Research, Development and Training (HRC), in Hangzhou, with the support and co-operation of UNDP, UNIDO and ESCAP.

14. In July 1982, A Senior Expert Group Meeting on small/mini hydropower was held jointly by UNDP, UNIDO, ESCAP and China, which recommended that an ESCAP Regional Network for Small Hydropower (RN-SHP) should be established within the framework of the Regional Energy Development Programme (REDP) of ESCAP, and with the Hangzhou Regional Centre for Small Hydropower (HRC) acting as its interim secretariat and its director as the RN-SHP co-ordinator. It further recommended that a Technical Advisory Group (TAG) be established, consisting of heads or senior officers of national organizations directly responsible for small hydropower development. The TAG, which was to meet once a year, would be expected to provide guidance to the RN-SHP co-ordinator in the formulation of the work programme, project activities and their implementation, and give advice to the Senior Co-ordinator of the REDP.

15. The Steering Committee of the REDP at its First Session in May 1983 took note of the report of the Senior Expert Group and the recommendations contained therein, including the establishment of the RN-SHP, and stated that the RN-SHP was not to be viewed as an institution, but as representing a co-operative arrangement among member institutions for carrying out specific activities. The Steering Committee agreed that REDP support should be provided for well-defined activities carried out within the RN-SHP framework, taking into account the work programme proposed by the Third Small Hydropower Workshop, held at Kuala Lumpur, Malaysia, in March 1983, and further confirmed that the Technical Advisory Group, which would assist the Steering Committee to provide overall guidance for the RN-SHP, would be formed by requesting the REDP national focal points to nominate national subfocal points for small hydropower.

16. Since its official establishment, the RN-SHP had limited possibilities of initiating project activities due to extreme financial constraints. For this reason, emphasis was focused on implementing workshops in two priority areas identified by the Senior Expert Group, i.e. the First Training Workshop in Mini-Small Hydropower, at Hangzhou, China, in May/June 1983, and the Second Training Workshop on Hydrology for Small Hydropower Generation at Hangzhou, China, in September 1984.

17. With the transition of the REDP from Phase I to Phase II and the official approval of Phase II (RAS/84/001), as well as other resources made available by UNDP under RAS/80/033, it has become necessary to review the past work, and assess priority needs for future activities in order to systematically respond to identified areas and subjects of common concern, needs and importance to the member countries in the field of small hydropower development and applications.

18. The First Technical Advisory Group, intitially scheduled for mid-1983, was not convened due to lack of activities on the one hand, and lack of resources on the other, however, at the point of transition of REDP, it was considered not only useful but even of significant importance that it be held as soon as possible.

Organization

19. The First Meeting of the Technical Advisory Group was held from 11-13 December 1984 at the Wanghu Hotel, Hangzhou, P.R. China, jointly by the Secretariat of the Regional Network for Small Hydropower and UNIDO, in co-operation with the ESCAP-Regional Energy Development Programme and the Government of China through the Ministry of Water Resources and Electric Power. The Meeting was attended by eight representatives from five national Subfocal Points for Small Hydropower. The Interim Co-ordinator of the Regional Network for Small Hydropower, together with two staff members of the Secretariat, the Senior Co-ordinator of the ESCAP-Regional Energy Development Programme, as well as a representative from UNIDO, and seven observers from the host country also participated in the Meeting. A List of Participants is attached as Annex I.

Objectives

20. The Technical Advisory Group had the following objectives:

a) to review and evaluate activities undertaken by the Regional Network for Small Hydropower during 1982/83/84;

b) to consider and develop guidelines for future activities during 1984/85/86;

c) to identify priority subject areas and projects at the national level with regional significance;

d) to exchange views on the decentralization of RN-SHP activities for strengthening Network activities;

e) to exchange views on ways and means of securing necessary financial resources for implementing the work programme;

f) to exchange views on how to increase the number of designated national subfocal points for small hydropower as a functional element of the RN-SHP;

g) to review and recommend the membership composition of the Technical Advisory Group and frequency of meetings.

Post-meeting visits to Suzhou and Shanghai were organized by the Ministry of Water Resources and Electric Power and the RN-SHP Secretariat.

Opening Ceremony (Agenda Item 1)

21. The opening ceremony was held at the Zhejiang Hotel, Hangzhou. Mr. Deng Bingli, Deputy Director, Department of Rural Electrification in charge of small hydropower, Ministry of Water Resources and Electric Power, Beijing, welcomed the First Technical Advisory Group Meeting participants, many of them old friends with whom he had attended previous meetings together. He mentioned that the Chinese Government through the Ministry of Water Resources and Electric Power made great efforts to establish the Hangzhou Regional Centre for Small Hydropower, providing funds amounting up to 6.5 million Yuan RMB, some US$2.6 million, for civil construction work including a well equipped, fourteen storied main building for research, training, information and consultancy, which was expected to be completed in 1986. He expressed his belief that the First Technical Advisory Group Meeting would have profound significance in the field of SHP development among the countries of the region.

23. Mr. Zhong Shijie, Director of the Department of Water Conservancy of Zhejiang Province, Hangzhou, referred to the historical interlinkage of water and the Zhejiang Province, with more than 6,000 SHP stations and a total installed capacity of 600 MW constructed for the economic and social benefit of the population.

24. Mr. Zhang Fangyu, Chief Secretary, Municipal Government of Hangzhou, speaking on behalf of the Mayor, expressed the continuation of their open-door policy which led to the setting up of many close links with foreign countries, particularly in the neighbouring Asia-Pacific countries. Since the creation of the Hangzhou Regional Centre and the Regional Network for Small Hydropower, many foreign specialists and UN officials had visited Hangzhou and he felt it was a great honour for Hangzhou. He wished the participants successful deliberations and a pleasant stay in Hangzhou.

25. Mr. F. Harahap, Senior Co-ordinator of the Regional Energy Development Programme - ESCAP, Bangkok, brought the greetings of Mr. S.A.M.S. Kibria, Executive Secretary of ESCAP. He emphasized the significance of the work of the Technical Advisory Group which was to review progress achieved and provide guidance to the Interim Co-ordinator in the formulation of the work programme, project activities, and their implementation for the coming 1985/86 biennium, and that the results would constitute valuable inputs for the Thrid Session of the REDP Steering Committee in providing overall guidance on co-operative activities in the field of SHP in the region.

26. The Head of the Development and Transfer of Technology Branch of UNIDO, Vienna, conveyed the greetings of Mr. M. Kulessa, Resident Representative of the UNDP/Beijing, and of the Director, Division for Industrial Studies of UNIDO, to the participants of the Technical Advisory Group. He then commended the excellent work carried out by the RN-SHP Secretariat in spite of the extreme constraints on the financial resources, and also expressed his thanks for the strong support provided by the Government of China. He emphasized the importance to make a critical review of the past
2 1/2 years which would lead to formulate recommendations for the Interim Co-ordinator to carry out realistic and practical activities that would respond to the priority needs and bring positive impacts in the development of SHP programmes in the member countris, during the forthcoming years.

27. Mr. Zhu Xiaozhang, Interim Co-ordinator of the Regional Network for Small Hydropower, referred to the experiences gained during the recent consultation mission to three member countries of RN-SHP, and emphasized the great expectations he and his colleagues within and outside the Centre had on the results of the TAG Meeting.

Election of Officers (Agenda Item 2)

28. Before going into the nomination of the Meeting officers, Mr. Zhu Xiaozhang, Interim Co-ordinator of the Regional Network for Small Hydropower, expressed his feelings that as he was participating in the capacity of the Interim Co-ordinator, it seemed inappropriate that the usual UN procedure be followed where the host country assumes the chairmanship of the Meeting. The Group accordingly elected Ms. Zenaida Santos, Executive Director, Mini-hydro Development Office, National Electrification Administration, Philippines, as Chairperson, and Mr. R.B. Shrestha, Project Director, Small Hydel Development Board, Nepal, as Rapporteur.

29. The participants were then given the opportunity to visit the site of the Hangzhou Regional Centre and inspect the facilities available for the RN-SHP Secretariat. After visiting the documentary exhibition on the Historical Development of the RN-SHP activities, the participants viewed four video films on small hydropower prepared by the RN-SHP Secretariat, and one film, although still in its unedited form, prepared by NEA/Bangkok.

Adoption of Agenda (Agenda Item 3)

30. The Meeting adoped the following agenda:

1) Opening of the Meeting
2) Election of Officers
3) Adoption of Agenda
4) Review and evaluation of activities during 1982/83/84
5) Guidelines for future activities of the RN-SHP
   a) Proposal for 1984/85/86 by the Interim Co-ordinator
   b) Priority subject areas and projects
   c) Decentralization of RN-SHP activities
   d) Strengthening of Network activities
6) Financial resources
7) Designation of national Sub-Focal Points for SHP
8) Technical Advisory Group membership and meetings
9) Recommendations
10) Date and venue of next meeting
11) Other matters
12) Adoption of the report
13) Closure of the Meeting

31. As background material, a number of documents were prepared by the Secretariat of RN-SHP, UNIDO, as well as TAG member countries, as per List of Documents, attached as Annex II.

III. SUMMARY OF DISCUSSIONS

Review and Evaluation of Activities during 1982/83/84 (Agenda Item 4)

32. The Interim Co-ordinator introduced activities implemented during 1982-1984 under the RN-SHP, based on document ID/WG.433/5. He stated that the scope of work of the RN-SHP during the period under review was based on the recommendations of the Senior Expert Group Meeting held in July 1982 in Hangzhou, which could be summarized as follows:

a) to organize an information service, covering both technical and general aspects;

b) to accept or recommend candidates for training from other focal points;

c) to make available short-term advisory services;

d) to undertake R&D projects depending on the facilities available to the focal points;

e) to organize meetings for the benefit of the Network; and

f) to establish links with institutions outside the Network.

33. He reported on the sources of funding for setting up the Hangzhou Regional Centre for SHP, as well as for starting up the RN-SHP activities, as given in Table 1.

Table 1:

Source of Funds since November 1981

	US$	
UNDP		
DP/RAS/80/001 (ESCAP-REDP-UNIDO)	70,000	
DP/RAS/80/033 (UNDP-UNIDO)	347,000	
DP/CPR/81/004 (UNDP-UNIDO)	220,000	
	637,000	
Government of the P.R. China		
(RMB 2 million) + salaries and overheads	800,000	
UNIDO		
administrative support (in kind)		
Additions since 1984		
UNDP		
DP/RAS/80/033 (July 1984) (REDP-UNIDO)	36,000	) Hydrology workshop
DP/RAS/80/033 (Aug. 1984) (UNDP-UNIDO)	200,000	) for 1985/86
DP/RAS/84/001 (Oct. 1984) (REDP-UNIDO)	100,000	
Government of the P.R. China (April 1984)		
(RMB 4 million) for Phase II buildings	1,600,000	

34. Regarding the activities carried out, the following discussions emerged:

35. It was agreed that the RN-SHP Newsletter, so far two issues, kept the Network lively through exchange of views and news, both administrative and technical. It was, however, pointed out that there was further scope for improvement. In this connection, it was suggested that a more active contribution from the member Sub-Focal Points could further improve the usefulness of the Newsletter.

36. As to the two training workshops organized by the Hangzhou Regional Centre, it was confirmed that these were relevant to the needs of the participating members, and the teaching material was considered to be useful for designers and the people involved in SHP activities.

37. The representative of Nepal indicated that the training workshops held under the RN-SHP were useful, and the training materials from those sources are still being used in Nepal until now. He further called for more training workshops in the future.

38. The representatives of Sri Lanka and Thailand expressed satisfaction with the past work of the Network.

39. The Senior Co-ordinator of REDP commended the Hangzhou Regional Centre for providing the service of the Interim Co-ordinator and staff support for the Regional Network on Small Hydropower, and stated that considering the difficult years of constrained financial allocations during the last three years, the achievements of the Regional Network were very satisfactory.

40. The representative of UNIDO commended the achievements of the RN-SHP as reported and urged that other countries start to assume larger responsibility in development of the Network.

41. Regarding the "research and development project on telemetry and automation of Panxi Cascade Stations", on the query from the representative of UNIDO whether similar activities exist in other member countries of the region, the Interim Co-ordinator indicated that, as far as he was aware, no other similar research project existed in the area, and that co-operative research on this subject would not be feasible at this stage in the light of available budgetary means. However, the project would be open for demonstration to future training workshops and consultation missions.

42. On the proposed co-operative research and development project on "Application and local assembling of electronic load controllers at SHP stations in the ESCAP region" in 1985, the representative of Thailand queried whether the Electronic Load Controller (ELC) is applicable for systems larger than 100 kW. The Interim Co-ordinator stated that at the present state of technology, it is not available. He further indicated that two other member countries would be involved in the R&D project on local assembly and application of low-cost electronic load controllers at micro-hydro power stations.

43. The representatives of Thailand, Sri Lanka and Nepal strongly supported this activity. However, they felt that the allocated funds were too low, and suggested that additional funds be secured by UNIDO/UNDP.

44. The TAG members discussed communication difficulties regarding the questionnaires for the compilation of rosters on regional experts, research organizations and equipment manufacturers, etc. The Interim Co-ordinator stated that three questionnaires were sent out in May 1984 and that the response was so far rather poor.

45. On the ongoing activity of compilation of video films, the representative of UNIDO informed the meeting that consultations were being made with the Public Relations Section of UNIDO on the production of video scenarios. He felt that the production should be carried out on a co-operative basis among the member organizations.

Guidelines for Future Activities of the RN-SHP
Proposal for 1984/85/86 by the Interim Co-ordinator
(Agenda Item 5(a))

46. The Interim Co-ordinator introduced a proposal for the 1984-1986 work programme, and indicated that funds would be allocated from two sources, i.e. REDP Phase II, RAS/84/001 - US$100,000 and RAS/80/033 - US$200,000. He then stated that a preliminary list for allocations for various components of the work programme was prepared on the basis of recommendations of previous meetings, as well as discussions with UNIDO, UNDP and ESCAP-REDP during the past two years. The proposals were prepared as a basis for consideration by the Technical Advisory Group to arrange priority activities as appropriate for the effective use of the allocations available for 1985/1986, amounting to approximately US$270,000 from both sources.

47. In the ensuing discussions, the TAG concluded that the preliminary list of proposals should be revised and updated, as priorities have changed during the course of the past two years, and because of the limited budget available.

48. The representative of the Philippines supported the publication of the quarterly RN-SHP newsletter.

49. The representative of Thailand stated that the proposal for holding a third training workshop on "Simple Low-Cost Feasibility Study for Small Hydropower" in 1985 was similar to the proposal made in the country paper of Thailand. All members of the TAG supported the topic for the third workshop.

50. All members of the TAG supported and endorsed the proposal for holding a fourth training workshop on "Design of Small Hydropower Stations particularly emphasizing simplified low-cost civil construction methods". However, it was stressed that funds for this activity be allocated from existing budget, in order not to be dependent on additional extra-budgetary funds.

51. All TAG members stated that each country had its own project on the subject of "Selection of locally available materials and its utilization in an inexpensive way for the construction of SHP stations", as proposed in the preliminary list of the RN-SHP Secretariat. Therefore, it was felt it might not be a most suitable project for a joint/co-operative R+D project, but an exchange of information and experience on this subject might be taken up as one of the Headquarters activities of the RN-SHP Secretariat.

52. The representative of Nepal proposed a joint research project to be undertaken under the RN-SHP on "Optimum Design of SHP Systems using Computer", which was also extensively discussed with the Consultation Mission of the RN-SHP Secretariat to his country in November 1984. The TAG agreed to include this in the 1985/1986 activities programme.

53. On the updating and expansion of various directories i.e. R&D activities related to SHP; SHP bibliography; SHP experts roster; engineering and consulting companies engaged to SHP; SHP equipment manufacturers; SHP stations in operation; SHP training activities, etc.; the UNIDO representative stated that considerable information and data had already been compiled in UNIDO within the framework of the UNIDO-INTIB, and they could be deployed as input to this activity. In view of this, the representative of the Philippines proposed that allocation of budget made for this activity in the preliminary list could be reduced.

54. On the proposed short-term consultancy services on R&D; local manufacturing of SHP equipment; feasibility studies; SHP construction; equipment selection, etc.; with an allocation of US$5,000 respectively for 1985 and 1986, the representative from Nepal stated that this activity was important, and queried the nature of these consultancies, because he felt that the proposed allocations were too small to achieve significant results. The Interim Co-ordinator clarified that the experts undertaking the consultancies may come from the Hangzhou Regional Centre as well as from other selected member countries.

55. On the production of video films for SHP training with a proposed allocation of US$50,000 for 1985 and additional funds for 1986, all TAG members agreed that this budget allocation could be reduced significantly, as each contributing country could make their own shooting, subject to the scenario being made available. In this case, the editing could be carried out at the Secretariat of the RN-SHP. The representative of UNIDO proposed that production of video films for public relations might also be considered as it would be important for the development of SHP in general and the RN-SHP in particular. It was subsequently agreed that the convening of an expert group meeting to discuss this matter should be included in the 1985/1986 work programme.

Priority Subject Areas and Projects
(Agenda Item 5(b))

56. The TAG members agreed to consider all potential co-operative R&D projects and to establish a priority list, with the strategic approach of accommodating top priority projects for implementation with presently available budget, while the remaining proposals be put into a format appropriate for presentation by UNIDO to prospective donor countries to solicit needed support. The proposals prepared by the TAG members have been issued as a separate document (ID/WG.433/21).

Decentralization of RN-SHP Activities
(Agenda Item 5(c))

57. The representative of UNIDO introduced the basic idea and need for decentralized project implementation as described in document ID/WG.433/4. This approach was felt appropriate to fortify the role of the Hangzhou Regional Centre as the Secretariat of the RN-SHP, since implementation of the work programme components, including the preparation of basic and background documentation, the organization, as well as the bearing of the hosting cost for the respective activities, could be better shared among participating member countries towards achieving a reasonable level of activity-implementation under the RN-SHP.

58. The representative of Thailand stated that his country would be prepared to host an apprenticeship/fellowship programme to share Thailand's experience in the construction, operation and maintenance of micro-hydropower plants under a co-operative management scheme with the strong involvement of the local community concerned.

59. The representative of Nepal felt that it would be more effective if present efforts were to be oriented primarily to strengthen the Secretariat for RN-SHP, and secondarily for decentralization of implementation of activities.

60. The representatives of China and Sri Lanka expressed agreement and supported the implementation of the decentralization idea.

61. The TAG adopted and recommended the concept of decentralization of activities under the RN-SHP.

Strengthening of Network Activities
(Agenda Item 5(d)

62. The Interim Co-ordinator introduced the report of the Consultation Mission which he and his staff undertook in October/November 1984 to Thailand, Nepal and the Philippines. The TAG felt that such missions would be extremely useful in establishing contacts and strengthening Network activities. The TAG proposed that similar consultation missions be organized in the future and arrangements be made so as to also include a selected number of representatives from participating member countries.

63. From the ensuing discussions, the TAG further proposed that subject to availability of funds, bilateral consultation missions might also be organized in the future.

Financial Resources
(Agenda Item 6)

64. The TAG considered the relative importance of the work programme elements, and agreed on the following order of priority for allocation of available financial resources for the period 1985-1986:

a) Training workshops
b) TAG meetings
c) Co-operative research
d) Information packaging and exchange
e) Consultation/study missions
f) Video film production
g) Support for the Secretariat.

65. After carefully considering the various topics proposed by the participating member countries and the Secretariat, the TAG agreed for implementation under the programme element training workshops, on the following ordering of priority:

a) Simplified Low-Cost and Standardized Feasibility Study for SHP
b) Low-Cost Simplified Civil Design for SHP
c) Simple Low-Cost Turbines
d) Operation and Maintenance of SHP Plants
e) Construction Management of SHP Plants
f) Social and Environmental Aspects of SHP Projects

66. Consistent with the strategy stipulated under Agenda Item 5(b) the TAG selected training topics a) and b) for implementation during 1985-1986 with financing from the available funds. The remaining topics would be formulated into proposals appropriate for presentation to donor countries by UNIDO for needed support.

67. The following priority list was decided by the TAG on topics for co-operative research for the period 1985-1986, after examining country proposals as well as those made by the Secretariat:

a) Optimum Computer Based Design of SHP Systems
b) Electronic Load Controller for Plants smaller than 100KW
c) Simple Low-Cost Feasibility Study Methodology for SHP
d) Electronic Load Controller Design as Frequency Sensor/Governor
e) Remote Control and Unattended Operations for SHP Plants
f) Preparation of Design Manual for SHP.

68. Similar to the strategy applied for training topics, the TAG selected co-operative research topics a), b) and c) for implementation during the period 1985-1986 with financing from existing funds. The TAG requested the representative of UNIDO to solicit donor countries for needed support for the remaining co-operative research topics, subject to their formulation into appropriate formats. The TAG urged the member countries to provide UNIDO with necessary and relevant information as well as their co-operation so that UNIDO could duly discharge their above-mentioned tasks in the nearest future.

69. The TAG adopted the allocations of available funds as per Table 2.

Designation of National Sub-Focal Points for SHP
(Agenda Item 7)

70. The TAG strongly recommends that the REDP Senior Co-ordinator be requested to urge the member countries who had not yet nominated Sub-Focal Points for SHP, to take timely actions for such nominations, as this would be imperative for the effective functioning of the co-operative arrangement for specific SHP activities under the Network.

Table 2

RN-SHP PROGRAMME OF ACTIVITIES - 1985/1986

(Agenda Item 6)

Project items		1985	1986	Time	Venue	Participating countries
1.	Training workshop a) Simplified, low-cost and standardized feasibility study methodology	20,000	0	Nov. 1985	Hangzhou	Philippines China UNIDO
	b) Simplified, low-cost civil design and construction methods	38,000	0	Sept. 1985	Manila Kuala Lumpur Hangzhou	Philippines Malaysia China UNIDO
2.	Meetings T A G (Second and Third Sessions)	15,000	15,000	July/85 July/86	Manila Colombo	All Member Countries + UNIDO
3.	Co-operative R&D a) Optimum design of SHP systems using computer	15,000	15,000	Jan.85-Dec.86	Kathmandu	Nepal/China UNIDO
	b) ELC (Electronic Load Controller)	12,500	8,000	Jan.85-Dec.86	China Nepal Sri Lanka	China/Nepal/Sri Lanka UNIDO
	c) Simple, low-cost feasbility study methodology	20,000	0	Jan.-Nov.85	Manila Vienna	Phil/China UNIDO
4.	Apprenticeship/fellowship Onsite training on operation and management	15,000	0	Jun.85	Bangkok	Thailand + selected member countries
5.	Information a) Newsletter	5,000	5,000	Jan.-Dec.	Hangzhou	RN-SHP UNIDO
	b) Roster	0	0	Jan.-Dec.	Vienna	UNIDO
6.	Missions a) Consultation/study missions	15,000	15,000	first half'85 + 1986	to be decided	RN-SHP All Members
	b) UNIDO advisory missions	5,000	5,000	second half'85 + 1986	to be decided	UNIDO RN-SHP
7.	Video films	15,000	4,000	Apr.86-Sept.87	Hangzhou	Member countries and UNIDO
8.	Secretariat support	15,000	15,000	1985/86	Hangzhou	RN-SHP
T O T A L		190,500	82,000			

Technical Advisory Group Membership and Meetings
(Agenda Item 8)

71. Three members of the TAG emphasized the importance of convening TAG meetings every year to support and guide the timely evolvement of the RN-SHP mechanism and its activities during its developmental stages towards its maturity. The limited budget available for TAG meetings, it was agreed, should not constitute a constraint. All TAG members endorsed the idea of organizing TAG meetings on the basis of promotional TCDC basis, where available allocation would be used only to finance international travel of TAG members, while the DSA would be contributed by the respective governments.

72. The TAG discussed its membership; however, it was decided that a flexible approach be adopted on this matter pending further increase in the nomination of sub-focal points for SHP by member governments. It was decided that for the second TAG meeting in 1985, invitations would be extended only to member countries who had nominated their respective sub-focal points for SHP.

73. As regards participating member countries of the RN-SHP from the Pacific, the TAG requested the representative of UNIDO to explore with the PEDP (Pacific Energy Development Programme) Project Manager for similar support such as is being provided by REDP for Asian participating member countries to permit the Pacific participating member countries to attend the second TAG meeting in July 1985.

74. The TAG meetings should be opened to selected donor agencies who would thereafter be designated as Co-operate Members and who would participate fully in the discussions but without voting rights at the TAG meetings.

Date and Venue of Next Meeting
(Agenda Item 10)

75. The second meeting of the TAG was set for early July 1985 in Manila, the Philippines.

Other matters
Agenda Item 11

76. The TAG took note of the plans regarding a high-level meeting planned in conjunction with the official inauguration of the new phase-II HRC building and facilities in 1986, and agreed to postpone discussions thereof to the second meeting of the TAG.

77. The TAG entrusted UNIDO to finalize the report of this meeting, and to make a summary of recommendations which would appear at the very beginning of this Report.

78. On behalf of all members, the Chair-person of the First TAG Meeting Ms. Zenaida Santos, thanked the Government of China through the Ministry of Water Resources and Electric Power and the Secretariat of the RN-SHP, for the excellent arrangements and the warm hospitality accorded to the participants of the meeting. In turn, the Interim Co-ordinator expressed his gratitudes for the guidance received from the UNIDO representative and the Senior Co-ordinator of REDP, and thanked all members of the TAG and all others involved for their active contributions and assistance.

Adoption of the Report
Agenda Item 12

79. The report of the first meeting of the TAG of the RN-SHP was adopted in the evening of 13 December 1984 at Hangzhou.

Closure of the Meeting
Agenda Item 13

80. The meeting was adjourned at 21.00 hours on 13 December 1984.

ANNEX I

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ANNEX II

LIST OF DOCUMENTS

ID/WG.433/1	Agenda
ID/WG.433/2	Annotated Agenda
ID/WG.433/3	Technical Advisory Group - Membership and Meetings
ID/WG.433/4	Decentralization of RN-SHP Activities
ID/WG.433/5	Review and Evaluation of Activities during 1982/83/84
ID/WG.433/6	Proposal for 1984/85/86
ID/WG.433/7	Designation of National Sub-Focal Points for Small Hydropower
ID/WG.433/8	Priority Subject Areas and Projects
ID/WG.433/9	Financial Resources
ID/WG.433/10	Strengthening of Network Activities
ID/WG.433/11	Future Funding of RN-SHP Activities
ID/WG.433/12	Hangzhou Regional Centre - Brief Report on Progress since November 1981
ID/WG.433/13	RN-SHP Consultation Mission Report
ID/WG.433/14	Potential Co-operative R+D Projects
ID/WG.433/15	Country Paper - China
ID/WG.433/16	Country Paper - Malaysia
ID/WG.433/17	Country Paper - Nepal
ID/WG.433/18	Country Paper - Philippines
ID/WG.433/19	Country Paper - Sri Lanka
ID/WG.433/20	Country Paper - Thailand
ID/WG.433/21	National Level Priority Subjects for the Promotion and Development of Small Hydropower
ID/WG.433/22	Report